INSECTS · SOCIAL BEHAVIOUR & ECOLOGY

Termites

Colonies, mound building, fungus farming and the hidden engine of the African savanna.

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> A termite mound is not just a pile of soil. It is a living, self-regulating system — termites, nursery chambers, ventilation pathways, food stores and, in fungus-growing termites such as *Macrotermes*, an underground fungal farm.

01 What are termites?

Termites are highly social insects in the order **Blattodea**, which makes them relatives of cockroaches. They live in colonies organised into specialised **castes**. Their colonies can profoundly shape soil, vegetation, decomposition and food webs — especially in African savannas and woodlands.

02 Main termite families

FAMILY	COMMON NAME	NOTES
Kalotermitidae	Drywood termites	Often live directly inside relatively dry wood and can keep colonies going without regular contact with soil.
Hodotermitidae	Harvester termites	Particularly important in Africa. Many collect dry grass and other plant material, and they are important prey for many animals.
Rhinotermitidae	Often subterranean	Many live in or closely with soil and build protected foraging routes such as mud tubes.
Termitidae	—	The largest and most diverse family, including many mound-building and fungus-growing termites.
Termopsidae	Dampwood termites	The traditional name for dampwood termites. Termite classification has changed a lot, and some older family groupings are treated differently in modern taxonomy.

03 The colony: the castes

PRIMARY REPRODUCTIVES

King & queen

Establish and maintain the colony. Unlike in ants, the termite king generally stays with the queen and keeps reproducing with her.

THE WORKFORCE

Workers

Build and repair the nest, collect food, care for the young, tend the fungus garden where there is one, and feed other colony members.

DEFENCE

Soldiers

Defend the colony with powerful mandibles and, in some species, chemical secretions.

FUTURE FOUNDERS

Alates

Winged reproductives. They leave mature colonies on reproductive flights, pair up, shed their wings and can found new colonies.

04 How a new mound starts — from alate to colony

1. **Swarming.** Mature colonies produce winged alates. Weather, rainfall, humidity and other environmental cues can trigger a reproductive flight.
2. **Pair formation.** A male and a female meet, shed their wings and become the future king and queen.
3. **Founding chamber.** The pair digs out or takes over a small, protected chamber. At this stage there are no millions of termites and no giant mound.
4. **First eggs and workers.** The queen lays eggs. The first workers develop and start collecting food, building the nest and caring for the next generation.
5. **Nest expansion.** As worker numbers grow, the colony excavates and builds more chambers, galleries and ventilation pathways.
6. **Mound development.** Over many years the colony keeps adding and remodelling soil and organic material. The mound you see is the result of continuous activity, not something built all at once.

05 Fungus farming — the *Termitomyces* partnership

Many African fungus-growing termites (subfamily **Macrotermitinae**) cultivate fungi of the genus ***Termitomyces***. The termites collect dead plant material and process it into a moist **fungus comb**. The fungus grows through it, breaks down tough plant compounds and produces fungal biomass that becomes an important food source.

THE BIG PICTURE

The termite is effectively running a farm inside the mound. It supplies the growing medium and controls the conditions; the fungus processes the plant material. A classic case of mutualism and long-term coevolution.

06 How does the fungus get into a new colony?

There are two transmission patterns. In **most** fungus-growing species, the new king and queen start their nest **without** the fungus. The first workers forage outside and pick up *Termitomyces* sexual spores from the

environment — spores linked to mushrooms produced by mature colonies — and carry them back with plant material to seed the first fungus comb.

IMPORTANT EXCEPTION

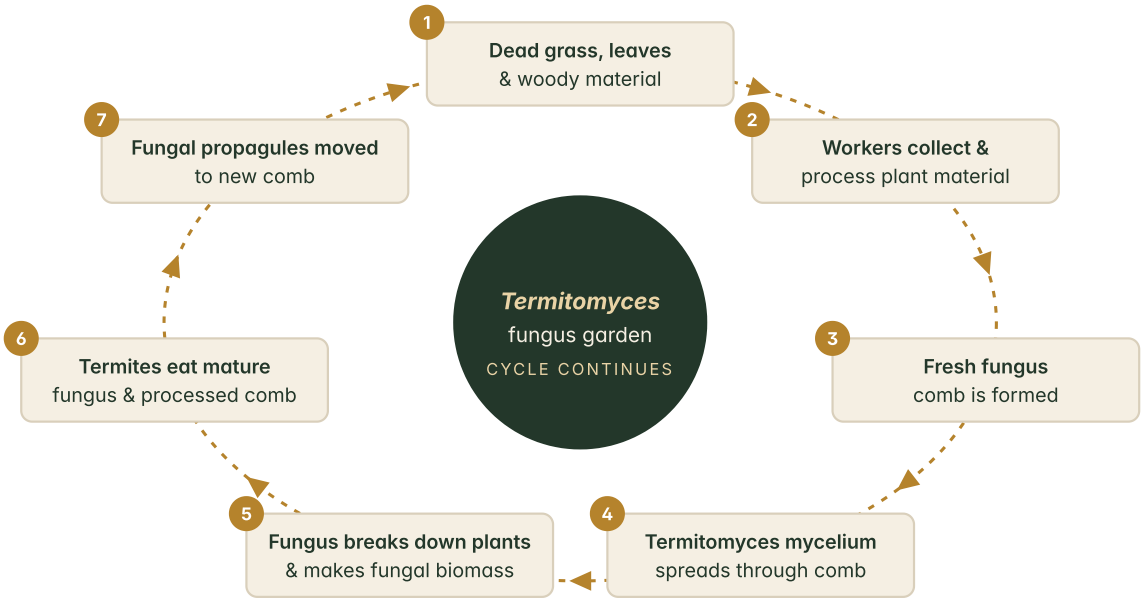
Vertical transmission has evolved in a small number of lineages. In *Macrotermes bellicosus*, the winged **male** carries fungal inoculum into the new colony. In the genus *Microtermes*, the winged **female** carries it. So it is not correct to say that both the king and queen always carry the fungus.

07 Where do the spores come from once the colony is established?

A mature *Termitomyces* culture can produce large mushroom-like **fruiting bodies**. These release sexual spores into the surrounding environment, where wind and other movement spreads them — the source used by many newly founded colonies.

Inside an established garden, though, the termites don't have to wait for a new mushroom every time they add material. Older comb contains fungal propagules, including asexual spores or nodules, and workers help move fungal material into fresh substrate. That lets the existing culture spread through newly added plant material.

08 The fungus-garden cycle



Inside the mound, workers keep the fungus garden going by moving fungal material into each new batch of comb.

09 How the mound works

The mound you see is only part of the nest. Depending on species and colony age, the main nest and fungus gardens may sit above ground, at ground level or below it. Mound and underground nest work together to buffer the colony from outside conditions.

Temperature control

Mound shape, wall thickness, soil properties, nest depth and ventilation all soften rapid outside temperature changes.

Ventilation & gas exchange

Networks of passages and temperature differences move air through the structure, exchanging oxygen and carbon dioxide.

Humidity control

Protected chambers and soil reduce drying; nest architecture helps keep moisture at the right level.

Physical protection

A safe environment for the queen, young termites, workers and fungus gardens.

Fungus cultivation

Special chambers provide a controlled environment for the fungus comb.

Continuous construction

Workers constantly repair, remove and add material, so the architecture changes as the colony and environment change.

10 Temperature inside the mound

There is no single temperature that applies to every mound. It depends on species, mound size and architecture, season, shade, soil and ventilation design. Fungus-growing termites generally keep their fungus chambers close to the conditions their *Termitomyces* partner needs.

Mid–high 20s °C

COMMONLY RECORDED

Fungus/nest temperatures in published field studies of *Macrotermes*.

29–32 °C

PREFERRED FUNGAL ENVIRONMENT

Where some descriptions and measurements place the fungus's preferred conditions.

25–28 °C

CLOSED MOUNDS, COOL SEASON

Diurnal means in one study; about 21–24 °C in an open mound.

> 27 °C

WARM SEASON

Warm-season means in the same study were generally above this.

That's why it's better to describe the mound as **temperature-buffered** rather than claiming every mound stays at exactly 30 °C. Fungus chambers can also show much smaller daily swings than the outside air: the architecture acts as passive climate control, and termite activity and construction fine-tune it further.

11 Why the mound needs ventilation

Millions of termites, growing fungus and decomposing plant material all affect the gases and heat inside the nest. Ventilation pathways exchange gases and redistribute heat. The exact mechanism differs between mound designs: some are more open, while others rely heavily on the thermal behaviour of enclosed passages and chambers.

12 Digestion and the termite gut

Termites feed on cellulose-rich plant material, but they don't digest it with their own enzymes alone. **Symbiotic microorganisms** in the gut help break down plant polymers. Fungus-growing termites have gone further and evolved an **external digestion system** — their *Termitomyces* gardens.

13 Termites as ecosystem engineers

Decomposition
They process dead grass, leaves and wood, speeding the movement of plant carbon and nutrients through the ecosystem.

Nutrient cycling
Mound material and termite activity redistribute nutrients and can create nutrient-rich patches.

Soil structure
Digging and building change soil porosity, mixing and water movement.

Water infiltration
Tunnels and altered soil structure influence how rain enters and moves through the soil.

Vegetation patterns
Mounds can support different plant communities from the surrounding soil, creating vegetation hotspots.

Food webs
Food for aardvarks, pangolins, aardwolves, birds, reptiles and many other predators.

Shelter
Old and abandoned mounds give other animals shelter or nesting sites.

Atmospheric gases
Decomposition and gut fermentation contribute to natural carbon dioxide and methane emissions.

14 The complete life cycle in one picture

1 Mature colony → 2 Winged alates produced → 3 Nuptial flight → 4 Male + female pair →
5 King + queen found a chamber → 6 First workers appear → 7 Fungus comb established & inoculated →
8 Workers collect plant material → 9 *Termitomyces* grows & processes the substrate →
10 Colony expands, mound develops → 11 Mature garden produces fruiting bodies →
12 Sexual spores enter the environment → 13 New colonies acquire the fungus → ↻ Cycle repeats

AT THE MOUND — HOW TO SAY IT

"A termite mound is basically a living building. The termites build it, heat and ventilate it, and constantly modify it. Inside, fungus-growing termites run a farm of Termitomyces. Workers bring in dead plant material, prepare it as fungus comb and let the fungus break it down."

"In most species, a new colony gets its first fungus from spores in the environment, collected by the first workers. But there are special exceptions: in Macrotermes bellicosus the new king carries the fungus, while in Microtermes the female does. Once it's established, the garden is constantly renewed by moving fungal material into fresh comb — and the mature fungus can push up mushrooms that release spores, connecting this hidden underground farm to the next generation of colonies."

15 Key terms

Alate	Winged reproductive termite.
King	Male reproductive that stays with the queen in the colony.
Queen	Primary female reproductive of the colony.
Worker	Non-reproductive caste responsible for most colony maintenance and foraging.
Soldier	Defensive caste.
Fungus comb / garden	Plant-based substrate cultivated by fungus-growing termites.
Mycelium	The network of fungal threads that grows through the substrate.
Fruiting body	The mushroom-producing structure of the fungus.
Basidiospore	A sexual spore produced by basidiomycete fungi such as *Termitomyces*.
Vertical transmission	Passing the fungal partner from the parent colony to the new one through a reproductive.
Horizontal transmission	Acquiring the fungal partner independently from the environment.

SCIENTIFIC NOTES & SOURCES

This guide uses the general biology of fungus-growing termites, with particular attention to *Macrotermes* and *Termitomyces*. Temperature figures are given as field-observed ranges, not a universal fixed mound temperature.

- Poulsen et al. (2015), *Environmental Microbiology* — termite–*Termitomyces* transmission, and vertical transmission in *Macrotermes bellicosus* and *Microtermes*.
- Korb et al. (2019) — termite mound architecture, nest temperature and fungal symbionts.
- Biedermann et al. (2018) — field research on temperature fluctuations inside savanna termite mounds.
- Aanen and colleagues — evolution and transmission of fungus-growing termite symbionts.
- Reviews of the termite–*Termitomyces* mutualism covering comb maintenance, fungal propagation and colony founding.

Scientific understanding of termite–fungus transmission is still developing. Where evidence differs among species, this guide points out the distinction rather than treating all termites as identical.

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